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ABSTRACT

The Natural Math project was undertaken to encourage parents of Native American and Black preschool and kindergarten children to engage in math activities and games at home. Natural Math also attempted to integrate Seminole culture into math materials. The project originally included only Seminole preschool and kindergarten children. Later, Boley school, located in a rural Black community, petitioned for inclusion. Natural Math activities included: (1) the provision of start-up supplies and other materials to the children and their families; (2) an initial meeting to explain the project and the proper use of the materials; (3) a portable computer lab; (4) a math fair; and (5) the distribution of materials for the summer. After their participation in the project, former Head Start children were tested for verbal, math, and social skills, and parents were surveyed. Participating students had higher raw scores than the students of the previous year. At Boley School, Natural Math materials were introduced to the children before they were given to parents, with several advantages resulting. An extensive literature review covers adult literacy and communication among Native Americans; a Native American perspective of giftedness; the role of culture in education; demographic and academic achievement data for six tribes; and Native American early childhood education and Head Start programs. A 36-item bibliography is included. (AC)

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Natural Math

A Progress Report on Implementation of a Family Involvement Project for Early Childhood Mathematics Among Children of the Oklahoma Seminole Head Start and Boley Head Start

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This project is for the children of Justice and Boley schools.

Presented to the Rocky Mountain Research Association

October 1992,Stillwater Oklahoma

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Abstract

This field research and development project has a goal of determining if family interaction in math activities with preschool (3 and 4 year old) children can lead to higher performance by the children at the kindergarten level and to a higher level of family-child interaction with math through activities and games. In the absence of clear evidence that cultural patterns cause lower achievement particularly in math, the basic assumption of the project is that all children regardless of culture have the potential to succeed in mathematics and that differences among groups are the result of patterns of learned behavior and not innate. Critical features of project development were consideration of the standards for the National Council for Teachers of Mathematics, the performance level of children entering kindergarten after the Head Start experience, the developmental needs of 3 and 4 year old children, consideration of current research on emergent literacy, and the cultural features of the Seminole people. During the first evaluation, teachers, parents and administrators expressed positive attitudes toward the activities while providing suggestions for improvement. A significant part of the project involved the use of art in the creation of materials appropriate for the children and families. Another popular feature was the limited use of cultural motifs such as the clan patterns in the creation of puzzles. The screening of kindergarten children who had been involved in the Natural Math project suggested that Natural Math results in improved raw scores of children entering kindergarten. The response of families to training sessions indicated that families are willing and interested in helping their child if provided with tools and suggestions.

Introduction

Helen Cheek stated that mathematics was the critical filter which excluded Indian students from access to education in such fields as medicine, engineering, and the sciences. (Cheek, 1983) Cheek went on to describe findings that Indian students performed poorer in mathematics than Blacks, Hispanics, and White students in spite of average performance on tests of intelligence. A review of the 1992 NEA report on Ph. D.s in higher education revealed that few Indians are teaching in higher education particularly in fields related to mathematics.

The question of why there is a disparity between expected and actual performance levels in mathematics among Indian students has been described and sometimes attributed to a conflict between the "learning styles" of Indian students and the teaching styles of primarily non-Indian teachers. Evidence that such "learning styles" are the basis of the poor performance in mathematics has not been specifically shown. Phillips (1983) observed differences in conversation etiquette and interaction styles particular to the Indian tribal members of the Warm Springs reservation. Children developed a distinct style of language interaction by the age of two even if the family did not live on the reservation or speak the native language (Phillips, 1983). The strength of the development of the personal interaction style among young children indicates the important influence of families on the thinking and interaction patterns of young children. These patterns of learned behavior seem resistant to change. Attempts to change the cultural style and language of Indian children has resulted in cultural tragedy for tribes throughout North America. Indian people in the 90's seem to be working to rebuild this important link to their heritage. In rebuilding the cultural link, can success in other areas be enhanced for Indian children?

Few projects which specifically addressed math improvement among Indian elementary students were found. The projects indicate little or no progress in changing the math achievement patterns among Indian children whether on or off reservations with one exception. (McLaughlin, 1982) No projects were located which specifically addressed emerging mathematics literacy

among Indian children. In math education however, interest in the constructivist approach in elementary mathematics has support by such theorists as Kamii (1990). Kamii argues that each person constructs their own knowledge of number through creating and coordinating relationships. Building on the work of Piaget, Kamii defines logico-mathematical knowledge as that which must be constructed by the child and the social knowledge as that which is passed on by the culture itself. There is no evidence to support Kamii's argument for the children of the Seminole tribe since no studies have been done with this particular population. However, Kamii presents a logical argument in favor of developing a wide knowledge of relationships with which subsequent construction of logico-mathematical knowledge can be constructed by the child. Kamii's observations have particularly strong implications for the children in this study.

This project was developed because of the low achievement of the children in a public school with a large population of Seminole children. Initial discussions with teachers and administrators led to a more complete analysis of test data which determined that mathematics was the lowest area for the students. In spite of extra tutoring and assistance through such programs as Chapter 1, the children were not achieving, particularly in mathematics. Parent support was another area which educators felt was low. School personnel described low levels of parent involvement in school functions and lack of encouragement to the children in such activities as completing homework. Parents were observed as they attended school open house functions. These observations tended to contradict the descriptions of Seminole[1] parents. Seminole parents seemed very interested in looking at the classroom and the work of the students. They also clustered with their children in small groups examining grade cards carefully. However, few of them seemed confident in approaching the teacher to talk. Conversations with the teachers seemed dominated by the white parents. These observations of parents indicated that lack of interest was perhaps not as important as the development of confidence in approaching school authorities. The consideration of how parents can become involved in the math success of their children began to emerge as issue to consider. Thus, issues of math achievement and parent involvement seemed to be essential elements for the success of these elementary school students. .

[1] Seminole is used to indicate the dominate Indian culture. Other Indian people such as Creeks are also present in the target population, although to a lesser degree.

Statement of the Problem

The issue of how math achievement can be enhanced among Indian children has not been well defined as to the relevant variables, the cultural context requirements, and whether or not "learning style" for mathematics is an actual difference among the groups or a learned behavior. The important role of the family in the early development of thinking and interaction[2] has been suggested by Phillips (1983). This study proposed to investigate the effects of early family and child math activities on school readiness and parent involvement.

Review of Related Literature

Academic achievement among Indian students seems to be evaluated from a global or monolithic perspective because of limited research evidence with respect to individual tribal units. This global approach tends to obscure some of the the real differences and needs of the various indigenous people, tribal units and various cultural settings. This minimal amount of data from tribes is one of the most important reasons why educational research has proven to be of limited value in solving specific educational problems for Indian people. In the search for answers and models on which to formulate a program, achievement among various tribes was reviewed because of lack of information available about Seminole Indian children. Factors which seem to be most germane to this project were: (1) the issues of adult's ability to help (adult literacy), (2) giftedness from an Indian perspective (what is important in the culture), (3) the role of culture in educational materials and instruction, (4) parent involvement and academic achievement, (5) emergent literacy and (6) meeting the standards of the National Council of Teachers of Mathematics.

1. Adult Literacy and Communication

Hosey and others (1983) conducted a study to determine how well Native Americans of the Northwest (Portland, Oregon area) comprehended the information published related to self care of diabetic conditions. Adult Indians in this Health Center had a high rate of diabetes and seemed to be unable to do effective self care. Testing revealed that the average literacy rate for 2/3 of the

[2] Interaction refers to oral communication, body language, play, and social interaction.

patients was about at the fifth grade level (n=56). The other 1/3 was below the fifth grade level on a modified Wide Range Achievement Test. A review of all the information pamphlets provided the clients revealed that the average readability for 17 commercially prepared pamphlets was at the 10th level. This project designed new pamphlets at or below the fifth grade reading level and included more culturally relevant language and illustrations. Follow up tests of clients showed that 74 % of the readers were able to read and understand the new materials at least at an instructional level. This study suggests that parent information which might be provided by schools consider the problem of readability. The critical factors seems to be

1. Readability at about the fifth grade level
2. Using graphics with culturally relevant features.
3. Minimizing shifts of ideas.
4. Large lowercase print and personalized tests.
5. Each booklet focused on one topic with a maximum of four learning objectives.

The role of adult literacy plays an important role in the parent involvement. Inability to read, write and compute easily is a serious barrier to families who might otherwise be willing to participate in school activities and work with their children. Attempts to develop parent involvement programs should consider the issue of adult literacy when considering options.

Communication with Native American Families.

Research relating to communication with families has been also studied as it relates to the fields of counseling. Everett, Proctor, and Cartmell summarized the barriers to service delivery to Native American children and their families relating to counseling services. Because of a shortage of non-Indian psychologists and counseling professionals, those providing such services are most likely to be non-Indian. While counseling services are not directly related to academic performance, the skills and cultural awareness necessary to counsel parents and students on a wide variety of topics relating to school and home can be enhanced with a better understanding of the needs of Indian students and families. This study provided some clues for communication with families but gave little specific information about the target population.

The role of oral language and the development of child-adult interactions was studied by Phillips (1983) through direct observation of two groups. Phillips affirmed the communication style differences between non-Indians of Madras, Oregon and the Native Americans of the Warms Springs Reservation. Her observations of individuals and groups as well as classrooms on the reservation and in town support views of researchers like Little-Soldier (1989) on the break down of verbal interaction among Native children after the early years. This breakdown may be related to the movement toward the more formal highly structured lecture/recitation mode referred to by Little-Soldier. Phillips compared the first and sixth grade students in both the non-Indian and Reservation schools. A distinct difference between the Indian children was noted. Sixth grade students rarely spoke in class while non-Indian children competed for verbal control of the classroom. Teachers who were primarily non-Indian give higher grades to students who are verbally involved in the classroom, according to Phillips.

Little-Soldier's (1989) comments concerning the role of Head Start in language development seem to be in agreement with the observations of Oklahoma Seminole children who came into the kindergarten from Head Start. Language interaction seemed to be greater among children who had participated in Head Start programs. Teachers of the Oklahoma Seminole children reported an increase in verbal activity among children who had previously attended Head Start. This development of oral fluency is a critical factor in the language success of children entering elementary school and influences the teachers' attitudes towards the students as being able or less able to function in the classroom.

The role of language development among young children has also been observed by Phillips (1983). Phillips observed families and the development of interaction patterns among the Warm Springs Indians. She indicated that children from the very beginning are expected to develop physical control of themselves and a calm response to events. Verbal excitement is not encouraged. Children develop a high receptive vocabulary and are expected to follow the verbal directions of adults. As children become older, they show their interest through the eyes instead of the whole face. Warm Springs Indians believe that older people (40+) should be the ones to speak rather than younger people. They believe that someone of that age has wisdom and verbal control.

Younger people are to do physical things while older people are the speakers. Physical control of the body in motion, such as balance, is prized and encouraged among the young as in dance and team sports. Babies are tossed in the air and playfully wrestled at a very young age. They are also kept close to an adult at all times. Children are used to being among many people all their lives and do not necessarily have one authority figure. Gestures and body language develop before children enter school. This mode of interaction is very resistant to change unlike language which may be lost through the generations. Speaking English is not the main problem in the classroom. It is the pattern of interactions which are confusing to Indian children when they reach school. They often do not comprehend the teacher's message and do not know the protocols for correct response. As children get older, they tend not to speak up in class because of the communication problem as well as the tendency of avoiding showing they know things and appearing above their friends. Indian people work together on projects without leaders in the non-Indian sense. The division of labor follows an invisible order which is cooperative. Children on group projects concentrate on the task with no need for someone to tell them what to do.

Some important points from the Phillips work for the classroom are:

1. Students may not respond in an observable way in large groups.
2. Students may not respond in an observable way in small groups.
3. Students may work better one to one or
4. Students may work better on a large group project and offer suggestions which are either accepted or ignored by others without comment.

Phillips describes the group interaction of adults. Adults preferred to sit in circles rather than rows. This was to prevent someone who may be mad at you from looking at your back which is considered a very terrible thing. The eyes are considered weapons which can damage another person with a glare.

Seminole of Florida

Robbins (1984) studied the relationship of juvenile delinquency and Indian social concepts among Seminole youths of Florida. Seminole youths between 10 and 15 years of age were studied

using a self report of delinquent activities. In addition, data were collected on the social relationships or "attachments" that these youths had. The study confirmed that Seminole youths like most youths report a high number of activities which fall into the category of delinquent. Seminole youths would select the "don't know" response when asked about the behavior of peers. Attachments among Indians were difficult to pin down using the instrument which is typically used to measure such attachments. In the discussion, Robbins explained that the culture of the Seminole family and extended family did not lend itself to the instrument used. Seminole family members rarely express personal feelings or affection within the family group. As one Seminole put it, "You don't say something that you already know." The family structure is different from the non-Indian family which made attachments difficult to trace. Children may go out alone at night and no one goes to look for the child. It is presumed they will return when they want to return. Parents in the non-Indian sense did not always do the parenting. One youth said that when his parents worked, the grandparent was the one who knew where the children were. When the grandmother died, he became the one who knew. While the "parent" role is defined differently, it is still present and workable within the traditional Seminole culture. Control of behavior has been reliable in the traditional Seminole family and tribal structure. No family wants children to misbehave or do the wrong thing. The traditional methods of control of behavior has eroded as the breakdown in culture and traditions has diminished. Robbins goes on to explain that the Seminole youth will express an non-Indian view when describing their relationships with teachers and others in the non-Indian society. Seminole youths seemed able to adapt their social behavior to the non-Indian or Seminole behavior with relative ease according to Robbins. The theory of social conflict or confusion seems to lack relevance. However, weakening the traditional tribal culture and control seemed to weaken the ability of members to maintain stable family and social relationships within the tribe. The dual social structure theory is unlikely to be well understood by school authorities and non-Indian society as a whole, which may lead to confusion among teachers and silence among Seminole students and families.

The search for other studies of the Seminoles with respect to learning have not been successful. Publications on the Oklahoma Seminoles have focused on cultural considerations and history. According to Howard and Lena (1984) the population of Oklahoma Seminoles at that time

was estimated to be over 9,000 as compared to 2,000 Florida Seminoles. The Seminole people vary in their views particularly with respect to culture. As a people, they tend to be intelligent, fiercely independent, and extremely talented in almost every area. Observations of children in the school setting reveals that children are very respectful to elders and teachers. This pattern seems to follow the general Seminole pattern of respect for older people. Seminole children in the classroom seem to be rarely in trouble for talking out of turn or disruptive behavior. In meetings where parents are present, children wander on their own and do not get into trouble. The Seminole people of Oklahoma seem respectful of individual privacy and do not speak out in groups when others who have more authority or wisdom are present. One may find the Oklahoma Seminole of today share many of the characteristics of other groups such as conversation etiquette, but they tend to be much more private in sharing their ideas and culture.

2. Giftedness from an Indian Perspective

Tonemah (1987) reviewed the concept of giftedness among Native Americans. He stressed the need for multi-dimensional assessment and reviews one survey of what giftedness means to Native Americans among 266 American Indian educators. High intelligence was ranked highest closely followed by high creativity, high academic achievement, high problem solving skills, self discipline, respect for tribal elders, leadership ability, respect for others, artistic talent, mathematics ability, task commitment and scientific ability. Qualities such as storytelling, athletic prowess, tribal cultural knowledge and language skills are also important attributes among Indian educators. Tonemah's summary is the basis of a assessment instrument which could be used to help in the identification of the gifted Native American. This instrument could also be useful in identifying curricular areas which are frequently neglected in the education of young Indian children particularly when tribal affiliations are disturbed. Indian children in today's schools have few opportunities to obtain basic information about their own particular tribal heritage and language or the heritage of other Native American groups. The non-Indian stream of culture has for the most part obscured the potential for knowledge of Native peoples. Giftedness is often viewed as a "something" that a person has in spite of environment and training, but just as the non-Indian and Native American view of giftedness includes both personal characteristics and environmental characteristics, the Native American child with potential gifts may not flourish in the absence of an

environment which provides the opportunity for learning and acquiring the gifts and skills. The American Indian Gifted and Talented Assessment Model (AIGTAM) may be a beginning point for a review of the differences in assessing giftedness in various areas. While mathematics and science play a role in this assessment, the AIGTAM criteria places a great emphasis on the skills and abilities which relate to cultural elements such as music, dance, storytelling and knowledge of culture. Those elements which are most prized in the Indian culture seem to be those which are the most neglected in the non-Indian culture.

3. The Role of Culture in Education

Education plays an important role in the transmisaion and maintenance of culture. Cultural relevance has been shown to be the critical difference for some children. The TIPS (Teaching in Pueblo Setting) program of the Santa Fe Indian School, has demonstrated that children of the Pueblos can be successful in science when teaching is done by high school students of the Santa Fe High School (Navahoe students). The project is a clear indication of the success of teaching within the culture and using the culture as a framework for education instead of imposing a new culture with education. High school students are currently teaching in the Laguna Elementary, Acoma Sky City Community School, Pueblos Pintado, Hotevilla Bacavi Community School, Tesuque Day School, Santa Clara, and Crownpoint. Jeremiah Cronin, project director, indicated that cultural relevance in one pueblo is not always well accepted in the next pueblo. His observations illustrate the complexities of ethnoscience and some problems in developing and implementing a culturally relevant curriculum for what may appear as a homogeneous group. (Cronin, 1992) The success of the program however, provides support to the argument that culturally relevant teaching can make a difference for learning subjects such as science which has been a traditionally difficult subject for indigenous people.

4. Demographic Information and Academic Achievement

Academic achievement among Native American people has been characterized by spotty success. In the following section, projects and studies which provide specific information regarding critical factors are included. Current census data on the status of the American Indian in Oklahoma have yet to be released. The following studies are by tribal affiliation wherever possible.

Benally (1987) summarized findings relating to American Indian Education in a review of educational issues. Keys ideas from this review are:

1. American Indians were one of the fastest growing and youngest ethnic groups in the country with the median age of 18 in 1984.

2. The school dropout rate of American Indians and Alaska Natives was the highest of all ethnic groups (29%).

3. With every year in school, the achievement gap between American Indians and white students widens especially in mathematics (2.4 years difference in the sixth grade).

4. Native Americans are the most poorly represented in the natural sciences most likely as Check (1983) states because mathematics forms the critical filter for success in the sciences.

5. Native American view themselves as hopelessly incompetent in math and science.

6. Opportunities to provide special help in math and science through university programs are mostly located in Colorado and New Mexico.

7. High rates of child neglect seems related to the frequency of dysfunctional families among Native Americans. With the break up of extended families, the traditional child rearing assistance support has disappeared and parents find it harder to be "good parents." Many Indians of today or their parents were reared in boarding schools away from their own home and have not had culturally appropriate models for child rearing.

8. Feelings of loss of control or power in their own lives contributes to a sense of frustration among Indians.

9. Parents have a lack of involvement with their child's teachers because they lack experience in interacting with school personnel and feel they do not understand the curricular and counseling needs of their children. They are doubtful about how their input might be received by the school and they do not wish to feel intimidated or appear foolish so they remain inactive...but they are not disinterested.

10. Outdoor education is particularly appropriate for Native American children because of the involvement in meaningful learning in a natural context.

Cheyenne

McLaughlin, et. al, (1983) reported successful outcomes in reading, spelling and

mathematics for the Behavior Analysis Model of Follow Though among the North Cheyenne children in a public school and BIA reservation school. Students who had been in the schools since kindergarten were classified as the cohort and those who had transferred into the school were the non-cohort group. Classrooms were identified as adhering to the program model and those which did not. Model implementation was defined as (a) use of the sponsor-approved curricula; (b) a functioning motivational system (token economy or contingency contracting); (c) use of parents and relatives as aides; (d) an emphasis on instruction in the basic academic skills. One hundred percent (100%) of the classrooms achieved at or above grade levels in reading in the classrooms where the model was implemented while 12.5% (cohort) and 50% (non-cohort) of the classrooms were at or above grade level in reading in non-implementation classrooms. Math achievement was 100% and 87.5% at or above grade level in model implementation classes while at 0% and 12.5% in non-implementation rooms was reported. Spelling was 62.5% at or above grade level in implementation as compared to 12.5% and 0% in non-implementation classrooms. Achievement was measured with the Wide Range Achievement Tests. (McLaughlin, et al,1983). This study indicates that when a good model of instruction is followed in the classroom there can be positive outcomes for Cheyenne children. It also shows that when classroom teachers leave out or substitute for important parts of the model of instruction, children do not do as well in the classroom. This study is important because it strongly refutes the notion that Indian children somehow lack the ability to perform in various academic areas.

Choctaw

The classroom language patterns of Choctaw (Mississippi) students were compared with non-Indian (Lawrence, Kansas) students to determine whether the perceived differences in language between non-Indian and Native American Indian students could be verified through observations. (Greenbaum, 1985) Analysis of tape recorded classroom interactions revealed a significant difference between the non-Indian and Choctaw students. Choctaw students had lower duration of utterance as a group, lower individual utterance durations, gazed at peers rather than the teacher or other objects more, participated in choral speaking more and made more butting-in interruptions, and required a longer pause before responding to questions. In addition, teachers of Choctaw students asked twice as many questions than teachers of non-Indian students. Choctaw

students seem to have a different standard of conversation etiquette than the non-Indian teachers. Teachers dominate and control the flow of conversation through switchboard participation. Teachers give cues and nonverbal indicators of when the teacher is finished talking and approval of students to participate in talking. Choctaw students are familiar with different conversation interaction customs and do not recognize the non-Indian patterns of nonverbal behaviors. Students also do not look at the teacher but instead gaze at each other perhaps seeking appropriate cues. This diminishes the observation of the teachers nonverbal switching signals.

Teachers may perceive Native Americans as inattentive, laconic, dull-witted, silent and unresponsive while Native Americans may perceive non-Indians as bossy and too directive. However, Choctaw students seem to differ from some other Native American cultural groups in being more disruptive and noisy as compared with Sioux, for example. Little research has been done on cross cultural differences in verbal behavior among the 300 American Indian tribes. The tendency to view Indians as having a single set of behaviors seems unrealistic (Greenbaum, 1985). Greenbaum indicated that Choctaw students' butting-in and disruptive behavior seemed to reflect a different set of social skills among the students rather than a deliberate attempt to misbehave. This pattern of disruption in the classroom seems to be characteristic of some minority classrooms. This study shows that differences in classroom conversation etiquette can be observed, but it would be misleading to suggest that this same pattern is present among Indians as a group. Seminole children do not seem to follow this conversation style. Observations indicate that they are usually more subdued and reticent in responding verbally. More work in the area of tribal conversation styles would be needed before accurate statements can be made on particular cultural units.

Cree (Alberta Canada)

Among Cree adolescents studied (Carnew & Clark, 1985) the use of tutoring and computers seemed to achieve some positive goals which tends to indicate that some forms of intervention can be successful. The degree to which "mentoring" can serve to interpret learning tasks within the framework of the culture may be a critical element in the process. Another question is the issue of how well the computer can serve as a culturally neutral tool for learning.

Carnew & Clerk (1985) report that efforts to intervene in the cognitive functioning of Cree

adolescents of Alberta Canada have met with mixed results. A program of cognitive education, introductory Logo, and extended computer activities, along with reading, writing and mathematics resulted in positive outcomes in cognitive functioning and improved achievement in all areas except mathematics. While attitudes toward academic subjects and schooling did not change, attendance was improved. Students responded favorable to the use of the word processor for writing activities seeming to prefer this to writing with paper and pencil.

Leith and Sientz, (1984) reported on successful teaching strategies in Northern Manitoba schools. Six teaching strategies under four major approaches were studied among both elementary and secondary students. These included the following:

A. Rational approach-teacher directed toward a generalization based on reason.

A-1 Demonstration-Questioning

A-2 Values Discussion

B. Guided Discovery Approach-Teacher guides students to take an active part in discovering relationships among phenomena either tight or open ended.

B-1 Activity Centers

B-2 Activity Sessions

C. The experimental approach-Use if the experimental method.

(scientific method)

D. Group Problem Solving

E. Information-Centered assignment-students work independently and search for information on a topic.

F. Individual Assignment

Student teachers used all of these strategies but Demonstrating-Questioning was the most popular at both elementary and secondary while Activity Sessions were the second most popular at the elementary level. Activity Sessions and Information-Centered tied for second at the secondary level. Elementary students preferred the Activity Sessions and Group Problem Solving strategies and liked least the Demonstration-Question and Information-Centered. Secondary students like the Values Discussion and Information-Centered and disliked Demonstration-Questioning.

Success was determined through observations and tests by teachers. Problem solving was most successful for elementary students and Individual Assignment was rated highest for secondary. Values discussions was deemed the least successful for both elementary and secondary. A Pearson product moment correlation between attitudes and success show no relationship between student attitudes towards strategy and the corresponding success. This study like other studies of Native American children tends to support the idea that group problem solving is the most successful for elementary students while individual assignments tend to be better for secondary students. Questioning techniques were least favored by the Indian students but most favored by the student teachers.

Ojibway (Alaska)

Persi and Brunatti (1987) compared the performance of low achieving Ojibway students to a matched group of non-Native students on the Category Test (relating to Full Scale IQ) and to explore test performance and levels of academic achievement. Results supported the contention that Natives would show better performance than non-Natives on a culture free test, however, the results also show that slow academic progress is related to lower levels of performance on psychometric intelligence measures such as the Category Test. Results of this study tend to confirm that culture free tests may be less biased toward Native American but at the same time, low performance on such tests are good predictors of academic performance.

McShane (1988) investigated the relationship of intellectual and psycholinguistic abilities to the achievement gains of Ojibway Indian reservation children. McShane concluded that knowledge of an upper elementary school Indian child's scores on the WISC-R Block Design, Object Assembly, and Picture Arrangement subtests, along with knowledge of ITPA Visual Association, Auditory Closure, Grammatic Closure and Sound Blending performances would provide educators or psychologists with valuable predictive information about the children's probable ability to make gains in reading, language and mathematics. McShane indicated that attention to the development of these skills might enhance the achievement levels of Indian children.

Browne's (1984) study of 197 Native Americans of the Northern plains on WISC-R scoring patterns drew attention to the lower variance on the verbal performance of Indian children with a standard deviation of 1.6 for the verbal average for the whole group, 1.7 for females and 1.6 for males. Younger children showed a slightly higher standard deviation of 1.7 as compared with older children (1.5). McShane did not specially deal with the low variance in the verbal performance of Indians compared with non-Indian but his data tends to indicate this same pattern of low variance in verbal performance. This seems consistent with the findings of Phillips (1983) whose studies of verbal patterns among Indians indicates that Indian children are not reinforced for verbal performance but for physical performance. Verbal development is considered a thing to come later in life according to the Phillips study. Browne's study tends to support the contention that Indian children often perform differently than general populations and particularly on right-hemispheric processing tasks such as Picture Completion, Mazes, Object Assembly,and Block Design. The results indicate that Indian children have higher performance level than verbal scores on the WISC-R. While this indicator may sometimes be used as an indication of intellectual disability, Browne supports the idea that this pattern is an indication of right hemispheric preferences among Indian children.

Tlingit (Alaska)

Guilmet (1984) reported that few Tlingit (Alaskan Native) students ever learned mathematical physics and no physics courses were offered in Tlingit high schools. Those who attempted physics failed miserably. He attributes this failure to the effect of cultural patterns of cognition. Tlingit and other native or subsistence cultures learn by imitating behavior of others with little oral language used by the "teacher." Learning and retention seemed best when the task was in a story context for the Tlingit.

Guilmet (1984, p. 12) supports his argument with Berland's theory that the social environment-effects contribute to cognitive development. Even non-verbal intelligence tests do not seem to adequately measure cognition because the theoretical basis of such tests tend to ignore situational causes of children's learning. Different cultural experiences can increase or retard the

rate at which a child may progress through Piaget's stages of cognitive development toward the goal of formal thinking. Ethnoscience would structure the teaching/learning model of science on the characteristics of teaching and learning that characterizes the culture of the student. Each stage of development would use Piagetion like tasks based on the cultural modality of the student as steps toward the goal of formal propositional thinking. Thus ethnocognition forms the framework for thinking, building on the indigenous knowledge base.

Questions to be asked in determining the ethnocognition parameters for developing a culturally relevant curriculum might include:

At what ages do children become involved in subsistence or living skill activities?

What subsistence or living skills are important in the group?

What activities do children observe prior to participation?

What oral descriptions of activities are heard by children of differing ages?

Do adults give oral descriptions of activities to the young regarding correct behavior?

Do adults intentionally or unintentionally model correct behavior?

Do young practice subsistence or living skill activities during play?

Do older children or peers help children learn the subsistence tasks?

Can we transfer the traditional teaching methods into the classroom?

Answers to these questions can provide clues to the development of an appropriate cognitive model for the cultural group of interest.

Guilmet (1984) provides a model of science development for Tlingit children based on their interaction with the physical world rather than the mathematical based science which predominates Western culture and tradition. Within the interactional model of science for the Tlingit, Guilmet includes the following guidelines:

1. Children acquire knowledge of the natural world by watching others rather than through oral descriptions of relationships and concepts.

2. Information is acquired in the context of use such as developing a wild game call to closely mimic the sound of the bird, or testing the snowcrust to determine whether a snowmobile can be supported.

3. Other examples of concept building through action include: using stones to count sets of objects, constructing a circle by using a rope fixed at one end and a stick at the other end, using stories to align tasks with traditional ways of working.

4. Use of task completion and ways of working to determine the cognitive level such as the ability to conserve when working with clay.

Guilmet (1984) explains that there is not presently a theoretical base to explain how children from different cultural contexts use different ways of working to achieve mastery of information and skills and at the same time move through the various Piagetian levels of cognition to the level of propositional thinking. Perhaps at this point one might go back to thinking about what has been said by Tonemah in describing the gifted Native American.

Over and over, the value of developing ability to use imagery for control and thinking is mentioned. Perhaps each culture moves through imagery in different ways. Ultimately each child from each culture must form a image bank and link it to the language strands which can prompt recall and manipulation. Perhaps the story links the relationship among the various images in the correct sequence. The essential feature of the story method is the strong link between image and word. Teachers' talk is not linked to images for the child and is therefore not meaningful. The cognitive development is therefore retarded to the lowest level at which the child can link image and language. By watching while the adult is showing and doing the child can more fully develop the link between image and concept. This is not only true for the ethnic minorities but for most children. Non-Indian culture tends to interpose and substitute language for experience so that the "experience of language becomes the reality", an abstract form of experience which often has no basis in living experience. This concept of language in non-Indian and Asian cultures is what sets them apart from learning patterns of minority and native peoples which is more focused in real, concrete, experiences with life.

Guilmet (1984) would seem to discount the notion that the Tlingit are living in an intellectually deprived subculture. The prevailing view that minority children do not achieve because of intellectual deprivation fails to take into account that children of every minority achieved

propositional thinking in the absence of "intellectual stimulation" as viewed from the traditional viewpoint. What is missing in the minority education is experience with language, science and mathematical models similar to the non-Indian or Asian experience which is the criteria for achievement in schools. The question is how can a transition from reality based thinking to abstract thinking on the non-Indian model be achieved without the loss of relevance of the minority culture and with the strength of traditional Western rational thinking? At what age can this be accomplished and in what way can this be done? Certainly, the Tlingit child will not achieve mastery of science without the mathematics which forms the foundation, but new steps to mathematical reasoning will need to be developed to achieve this objective.

Math Scores of Navahoe (Arizona and New Mexico), Choctaw

Cheek (1983) suggests that mathematics has become the "critical filter" which often prevents minority and females from attaining careers in high paying jobs. The amount of mathematics studied can serve as a predictor of future income. The low representation of Native Americans in occupations within the sciences and engineering may be related to this critical filter of mathematics which is required in all such programs. According to Cheek, Native American students at the tenth grade level performed poorer than black, Hispanics or White students. In the state of Washington, the average score for Native Americans in 1980 was at the 33rd percentile. Cheek further states that average standardized test scores of Mississippi junior high Choctaws range from 17.8 percentile in 1977 and went up to 26.3 percentile in 1979. During that same period 12th graders ranged from 5 to 18.1 percentile among Choctaw public school students.

Cheek indicates that educators today might most likely encounter students for whom "Indian English" is more common than American Indian language. This Indian English retains the phonemic patterning and phonological constrains characteristic of the community's traditional language. The Indian language rules have priority over the standard English rules. Word forms such as non-inflected forms of to be as well as sentence formation of the traditional language are typically carried over into the student's use of English. Other characteristics of Native American students related to language and ethnocognition are:

1. Sioux high school students performed significantly less well than non-Indian students

on tests of English grammar, vocabulary, and reading comprehension and less well than foreign students on reading comprehension.

2. Among 142 American Indian students from all over the United States given the test of English as a foreign language, 82% scored in the range needing some to considerable assistance in second language training in college.

3. Dropout rates are high among Indian students with only about 7% of the high school graduates completing college.

4. Eighty (80) Papago children taking the Illinois Test of Psycholinguistic Abilities were significantly below the norm group on 12 of 13 subtests the only exception being visual sequential memory.

5. Twenty-one (21) Nez Perce kindergarten children scored significantly lower than 21 comparable *non*-Indian kindergarten children on measures of receptive vocabulary, receptive syntax, and expressive syntax.

6. Sixty (60) Flathead children scored significantly higher than a norm group in manual expression and verbal expression, they scored significantly lower in auditory reception and auditory memory.

7. Forty-seven (47) American Indian kindergarten children scored significantly lower than 61 non-Indian rural kindergartners on a test of auditory comprehension of language both at the beginning of the school year and after 20 weeks of school, even though both groups showed significant gains in auditory comprehension over the 20 week period.

8. A sample of about 5,000 Navajo second grade students was about .7 of a grade level equivalent behind national norms on the paragraph meaning subtest of the Stanford Achievement Test and that this difference increased to a grade level equivalent of about 2.4 behind national norms in the sixth grade.

Cheek (1983) summarized the problems of Indian children attempting to acquire English language at the same time they are expected to master writing, math, and other content area skills. While these problems are not unique to Native American students, they occur among students who might be expected by teachers to have mastered English. Students who may use informal English orally may in fact have difficulty thinking in standard English patterns and comprehending

vocabulary which is beyond their speaking vocabulary. Some recommendations from the Cheek study are:

1. Activity based approaches in mathematics learning related to real world experience,

2. Use of computer assisted instruction to supplement the direct instruction. Computers provide the individual pacing and privacy which are conducive to the learning style of the Native American student.

Mentoring has been found to be effective in programs such as the Title II program for the Isleta Pueblo (Navahoe). The 1985-86 program report indicated that Algebra was the area most requested for tutoring. Improved achievement of competencies in all areas was found in at least 1/3 of the participants. Language (Spanish) and social studies achievement seemed to improve most over all among these students with middle school students seeming to make greatest gains.

Kaulback (1984) conducted a review of literature in which studies of Papago, Navajoe and Alaskan Inuit had been studied. Studies to that point in time, indicated a preference for visual processing of information and are most successful on visual tasks whereas tasks saturated with verbal content tend to be more difficult. Kaulback warns that such results may indicate that verbal tasks may be more related to the receptive and expressive levels of English language rather than an inability to process auditory information. He summarizes Berry's 1971 study of the visual spatial skills of the Inuit when compared with subjects from Sierra Leone, Africa. Inuit subjects far surpassed the Sierra Leone subjects on all measures of visual discrimination ability and spatial skills. He refers to Kleinfeld's study (1983) of the Inuit's remarkable visual skills in the literature on perceptual skills among the Eskimos in which asserts that perceptual strengths should be taken into account in teaching.

Schrankel and DeGracie (1986) analyzed the school records of the Mesa Public Schools (population 51,555 students) to determine the long term effectiveness of the Chapter 1 program and the interaction of the various other programs to which students might be assigned. The district population is primarily white non-Indian (84 percent), with Spanish surname the second largest category (10 percent) and Native American (2 percent) and Black (2 percent) the third largest

categories of students. The district provided Chapter 1, Indian Education, Migrant, and English as a Second Language (ESL) programs. Of interest in the study was the length of stay in various programs. Chapter 1 was 1.4 years, ESL 1.4 years, Indian Education 1.7 years, and Migrant Education 2 years. Longitudinal analysis of a first grade cohort with 3 and 4 years of service in Chapter 1 showed that the average reading and math NCE scores declined with increased length of services. Gains made were not sustained. In comparing the retention rates among program participants, Chapter 1 students were retained less often than other categorical programs. Native American students with 5.2 percent retention was higher than Migrant (4 percent) and less than the ESL programs with 8.7 percent. Overall, retention of students in the Indian Education program showed a pattern of increasing rates in the four years under study. Starting from a retention rate similar to Chapter 1 (2.3 percent) the rate rose to 5 percent in 1980-81. There was no change in 1982-83, but in 1983-84 the retention rate rose to 8 percent. The retention rate of the first graders remained at 12.5 percent in the first two years, rose to 18.1 percent in 1982-83, and declined to 16 percent in 1983-84. Retention tended to be highest in grades seven and eight with rates ranging from 14 to 100 percent. Services provided included were Title IV-A and Johnson O'Malley (JOM). The number of students participating ranged from 177 in 1980 to a high of 277 in 1982-83. Participants were divided almost equally by gender. While this analysis does not attempt to speculate on the reasons for the high retention rates among Native Americans, it does demonstrate that the students were viewed as Native American only (not by tribe) and that retention rates among these students increased rather than declined. The retention rates among ESL students might be attributed to lack of ability to function in English, no such logical explanation can be surmised to explain the retention of Native American students.

5. Emergent Literacy

Language Learning and Head Start

Little-Soldier (1989) summarized the socio-cultural context of language learning and made several important points. He stated that Head Start may have had a significant impact in launching Indian pupils into successful school careers. The Head Start emphasis on oral language skills seems to carry over into formal schooling. The early success with English and the involvement of

the families of pupils helps make a smoother transition from home to school. Little-Soldier also states that arrangement of the classroom seems to make a big difference to Indian children. Flexible, informal furniture arrangements conducive to group work seems to work well. According to Little-Soldier, teachers report that Indian students tend to be "field-sensitive learners". . They are in tune with their surroundings and function more effectively when a personal relationship with teachers has been established. When the classroom becomes more formal with the lecture/recitation mode and with rows of chairs, students tend to become more quiet and less actively involved in the oral interaction. Student to student dialogue, and group problem solving techniques should be used as often as possible with Native American learners since it encourages oral language. Teachers should model correct speaking for students but avoid correcting oral errors except during formal language lessons. Teachers should listen sincerely to what students have to say without interrupting. Little-Soldier suggests that teachers learn as much as possible about the families of children in the classroom such as their lifestyle, values, aspirations, etc. He is speaking primarily of Navajo culture. Little-Soldier's research among the Navahoe provides important insight into the important role of Head Start, however, teachers should keep in mind that attitudes towards privacy vary among tribes and families. This tendency towards privacy may prove to be a barrier in gaining information about lifestyle and values.

Early Childhood Education and Head Start.

Weikart (1988) gives strong evidence for the effectiveness of quality preschool programs for disadvantaged or at-risk children. Weikart cites the findings of the Perry Preschool Project which involved the long term study of the effects of preschool on a number of important societal factors including family demographics, child abilities, scholastic accomplishments, involvement in delinquent and criminal behavior, use of welfare assistance, and employment. When 123 students were studied at age 19, important differences were found between preschool attendees and non-attendees. Fewer preschool graduates were classified as mentally retarded, more completed high school, more attended college or job training, more preschool graduates held jobs, more supported themselves by their own or spouse's earnings, more were satisfied with work, fewer were arrested for criminal acts, more experienced a lower birth rate and fewer were on public assistance.

Weikart (1989) also cites the High/Scope preschool curriculum study as an example of how important good preschool curriculum is in fostering positive outcomes for children. It is not just preschool, but excellence in preschool, which Weikart advocates. Collaboration between teaching staff and parents as partners in the education of the young child is one of the characteristics of the excellent preschool program.

Not all educators believe that young children should participate in formal schooling experiences. Specifically, early childhood programs aimed at increasing the academic performance of young children have been called "miseducation" by Elkind (1986). Zigler (1986) also argues that we are driving children too hard and taking away their childhood with schooling that is harmful to their development. Their concern has been supported by a study of black children in which the extension of formal schooling to four year olds and kindergartners did not improve and in some cases hindered academic achievement and child development.

In spite of this concern about negative effects for formal schooling on the development of young children, other studies have found other long-term improvements among children who participated in Head Start. Copple (1987) found that Head Start children more often avoided serious school problems, had less retention in grade, had better attendance, and missed fewer standardized tests.

Rachal and Garbo (1988) found that early childhood participants were less likely to be retained and were less likely to be placed in special education classes. Rachal and Garbo suggest that the reduced placement may be due to the slightly elevated IQ scores immediately after Head Start and even though this effect levels off by fourth grade, most special education placement is done in the early grades.

Clement (1983) found Head Start graduates were more likely to complete high school. Sixty-seven percent were more likely to complete high school while 47 percent of the controls graduated. The rate of employment of 19 year olds was higher for those who had attended preschool (50%) as compared to non-preschoolers (32%). When studying rates of welfare

receivers, seventeen per cent (17%) of the preschool graduates received welfare as adults while thirty seven per cent (37%) of non-preschoolers received welfare as adults.

According to Caldwell (1987), studies of Head Start typically find that the measurable differences in those who do and do not attend Head Start disappear by the end of the second year of elementary school. The major effects seem to be in the social effects and in long term effects on retention and assignment to special education. In spite of the short term academic effects, the development of these positive outcomes seem to support the continuation of Head Start and expansion of the the program.

The implications of these studies on the present study seem to indicate that short term effects on academic performance may not be as important as the development of the skills needed to cope with formal schooling for both the children and their families.

6. Meeting the Standards of the National Council of Teachers of Mathematics

A critical variable in mathematical education for young children is appropriate instructional goals. The National Council of Teachers of Mathematics (NCTM) has defined the direction of mathematics education including the direction of mathematics education for the young child. Three goals have been published.(NCTM, 1989)

1. Address the relationship between young children and mathematics.
2. Recognize the importance of the qualitative dimensions of children's learning.
3. Build beliefs about what mathematics is, about what it means to know and do mathematics, and about children's view of themselves as mathematics learners.

The goals of the NCTM reflect the recognition that mathematical thinking is a multidimensional process in which children's attitudes towards mathematics and towards themselves as users of mathematics play a significant role in later studies. Thus, early experiences at home and school are critical in laying the foundations of emergent mathematics literacy just as they have been shown to do for language literacy. For this reason, home, family and culture of the child may play a critical role.

Summary

The literature on achievement in mathematics among Indian people seems limited. Likewise research as to how to improve the mathematics functioning of Indian children is sparse at this time. However, some useful information can be gleaned from the previous research. First, the family of the Indian child is the most important teacher of the child. Traditional values and ways of thinking seem to dominate all subsequent educational experience. Among the most valued ways of teaching is the use of stories and observation. Another important principle is that Indian families may include and value members of the extended family in interactions and child rearing activities. The term "parent" is too limited in describing who may influence the child. The Robbins (1984) study indicates the limitations of traditional social measures which describing the Indian family. Children may seek support from a wide variety of family members who function in a supportive role. Language skills seem to be a limiting factor in school learning, however, language skills and reading seem to be more readily influenced by educational programs with the exception being the Follow-through project previously described. Mathematics seems to be a significant stumbling block to many Indian people and is a significant barrier to subsequent training in many professional fields of study. In interviews with adult Seminoles who were college graduates or non-graduates, most all indicated that math was the hardest subject and they were poor in math. Adults seem to indicate a preference for avoiding math whenever possible. When math was mentioned, adults, both male and female, made fearful sounds, shook their heads and remarked negatively about their ability to do math. The success of Head Start has been a bright spot for both Indian and non-Indian children in making the transition to school and in subsequent school success. Head Start also has the potential and the directive to foster parent involvement.

Statement of the Hypothesis

The literature fails to provide evidence or specific guidelines relating to the issue of math education among the children of the Oklahoma Seminole tribe or few other Indian tribes. Testing reveals that students from many tribes perform lower in mathematical thinking yet a causal relationship between culture and math ability has not been shown. There is no evidence that

children of a particular culture will achieve or fail to achieve because of the influence of culture. There is strong evidence that Head Start, parent-child interaction, and expectations play an important role in the level of readiness for school and in the ability of of all children to cope with the school culture. Therefore, it was hypothesized that children whose families were involved with the child in math activities and experiences in the home would demonstrated higher scores on the ABC inventory and families will report increased levels of interaction on the Parent-Child Interaction Questionnaire.

Method

Selection of Subjects

The population for this study was preschool children of the Seminole Nation Head Start and Justice Elementary. The Seminole Nation of Oklahoma operates four Head Start classes in two locations in Seminole county Oklahoma. These classes include 3 and 4 year old's with a high population of Seminole children. Subjects were selected from the population by choosing all the children who attended the Seminole Nation Head Start and the kindergarten children who attended Justice elementary school during 1991 and 1992.

Although the original plan was limited to the Seminole Nation of Oklahoma, Boley School petitioned the project to participate. The Boley school students population is black and is located in a rural black community. Boley also has a Head Start program on the school site. Thus, students from the Boley Head Start and Boley kindergarten program were included in the project group. The number of students selected for the study was approximately 140 students in five Head Start and two Kindergarten classes.

Instruments

Because the study was initiated by the need expressed by Justice school, the screening instrument for the Justice kindergarten, the ABC Inventory was used to measure expected performance levels for children entering kindergarten at that school. The ABC inventory is a measure of both verbal, math, and social learning items. Math items included recognition of coins

and sorting them by size (penny, nickel, quarter), shape recognition, counting, body parts through drawing (one to one correspondence) and days of the week. The instrument is administered by the kindergarten teacher on a one-to-one basis. This instrument is limited in addressing the math standards of NCTM and includes some concepts which early childhood specialists consider inappropriate for the child of five (days of week) but this instrument was in use by the school and pretest data were available to facilitate the study. It also yielded raw data scores which could be used for comparison purposes.

The Parent Child Interaction Questionnaire was developed for this study by Linda Medearis. This self-report measure asked families to respond to statements related to family activities which included some form of mathematics or literacy. This instrument is similar to an instrument which is used to measure emerging literacy in reading. The researchers hoped to measure how families interacted with their children before and after participation in the project. Because of the characteristics of the population and the self-report nature used, this instrument was felt to have limited value. Specifically, literacy among some family members was limited. The inability to personally interview all the subject families is a serious limit to this instrument. Construct validity was supported by comparison with the concept of emerging literacy for preschoolers and comparison with the standards of the NCTM. (See Appendix A for copy of Instrument)

Interviews of teachers and parents were conducted at evaluation meetings to elicit further information on the progress of the project and areas in need of change. Notes and summaries of these meetings were collected by the project evaluator and project staff for mid-point evaluation and final evaluation. Observations of families at meetings were made to determine the interest level and understanding of the project among family members.

Additional data was collected through evaluation of the materials at presentations to teachers of varying tribes. The teacher evaluation instrument further asked them to describe additional cultural areas which they felt should be included in the project and whether they felt the project materials were appropriate for their populations. The purpose of this evaluation was to determine

how well the project seemed to be relating to the needs of the teachers of Head Start and the parents of children in their classes.

Design

A pre-experimental static-group comparison was used to compare screening data of the 1991 students (without Natural Math) and the 1992 students (with Natural Math).

Group	Assignment	N	Treatment	Posttest
1	Non-Random		No Natural Math	ABC Inventory
2	Non-Random		Natural Math	ABC Inventory

Figure 1. Pre-experimental Static-Group Comparison

The static-group comparison design is considered a "barely defensible" design but was used in this preliminary or exploratory study because of time limits, population limits, and the need to apply the only appropriate methodology consistent with the field conditions.

Limits

The failure to randomly select subjects for the control and experimental groups is the most serious limit of the research. In addition, because there was no pretest data, it is difficulty to determine how equal the groups were originally. Other potential threats to the study were history (maturation) and mortality (students leaving). The study is also limited by the limited control on whether or not families actually carry out the activities in the home. In addition, students entered Head Start during the year which meant some children and families entered the project after the start date.

Procedures

Upon notification of project approval, meetings were held with administrators of the Seminole Nation Head Start and Justice Elementary to confirm a timeline for implementation and set critical dates for family meetings. Project staff developed, published and put together the first take home packs. These start-up packs provided children and families with needed tools for working through the activities. Each pack included developmentally appropriate scissors, map pencils and sharpeners, glue, an activity calendar, a math story book written for the children, snowflake detectors and snowflake bingo games. Materials for this project were written and created by the Natural Math staff with emphasis on games and materials which were familiar enough and easy enough that inexperienced family members with low levels of math and reading abilities could participate.

A family meeting was held to explain the project and show family members how the materials might be used. Songs were sung together and the story was read aloud to parents and other family members in attendance to model the "reading aloud" part of the project. Refreshments were served and a considerable amount of time was devoted to getting acquainted and social interaction. Packets for families were given out to those in attendance, and additional packets to teachers of those children whose families were not present to be given to children at school. It was explained that the Natural Math project was for families and their children and was not specifically for use in the school. It was believed that teachers, with the heavy load already in their programs would be reluctant to accept additional outside tasks.

This pattern of monthly development and parent meetings was continued all spring with the addition of the portable computer lab with selected early childhood math programs. The purpose of this component was to allow parents to get acquainted with computers with their children before the children began using them in school and to see if children 3 and 4 years of age could satisfactorily use the computers. Parents were encouraged to explore the programs and tell what they thought of the use of computers with children.

During the month of May, a math fair was held in which stations were set up for children and their family members to visit and "test" their skill in a fun atmosphere. One booth let children make green frogs by folding a square into a triangle and placing it in a "pond." Another booth asked children to count as far as they could in English and Seminole. Children received carnival-type prizes after they finished the task at each booth.

In late spring, evaluation meetings were held in three locations to discuss the project with the project evaluator. Boley and Seminole Nation Head Start teachers, administrators, and parents were invited to attend. Suggestions to improve the project were made at that time.

During the summer, mail home packets were prepared to encourage parents to continue the pattern of family interaction. The only different criteria for the summer packs was the need to make sure that materials would be flat enough to mail in the standard mailing envelope. Staff members solved such problems of how to mail paint for the 4th of July painting materials used for the "design" objective.

A training session was held for Head Start teachers from various tribes throughout Oklahoma at the pre-service cooperative training. Teachers were given 1 1/2 hr. sessions working with the materials. Afterward, they were asked to evaluate the materials for appropriateness and usefulness in Head Start and for cultural relevance.

In August and early September, children from the Justice Head Start who were to attend the Justice kindergarten were screened by the kindergarten teacher. Scores of the control group had been collected from the previous year's screening.

A final evaluation meeting was held in late September with teachers and administrators of the schools involved in the projects to determine whether the project had met the project goals for the first year.

Results

A t-test for independent samples was used to analyze test data between the control and experimental groups. Descriptive statistics were also used to describe the outcome. No significant difference was found in the results of the t-test. The small number of subjects and inability to control for the degree of program involvement contributed to this outcome. However, the mean for the experimental group was larger than for the control group. (See Figure 2.)

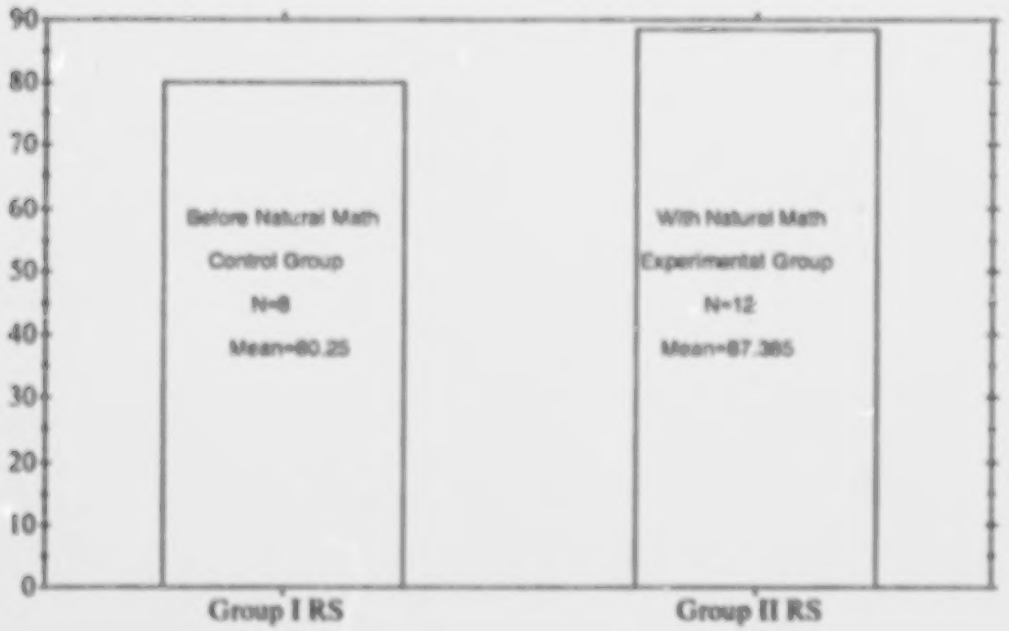

Figure 2 Comparison of Means of Screening Scores on ABC Inventory

The result of the statistical analysis is not surprising considering the size of the groups and the limited controls in the study. The experimental group included children who participated fully in Natural Math, those who had limited experience with Natural Math as well as some children who entered kindergarten without having Natural Math. Screening scores among kindergarten children provide a limited view of how well children are prepared to enter formal schooling. Test scores do indicate that a better performance of children on the screening test was obtained. In an observation of the children in the first few weeks of kindergarten, Natural Math children who had

fully participated seemed to be doing well in classroom activities.

Parent Questionnaires

Few questionnaires were returned by parents. Those who returned the questionnaires indicated that the Natural Math program had helped their children. Some parents said they had increased their use of math games and gave more attention to the use of numbers in the environment. They expressed appreciation for the materials. Parents were reluctant to offer criticisms but seemed to favor the stories, games, calendar activities, and puzzles. When choosing their favorite activities, fewer parents chose puppets. The researchers were unable to find out why puppets are less favored by this group, however the idea of famous Seminole "paper dolls" has been well received. When questioned about who interacted with the children, parents, uncles, aunts, cousins, grandparents, and friends were mentioned as participants. This tends to support the findings of Robbins (1984) in the importance of the extended family in support to children within the Seminole tribe.

Obtaining questionnaires from families was very difficult. Observations and one to one conversations with parents and family members proved more useful in gaining information.

Observations

In visits to Seminole Nation Head Start sites, teachers and administrators said that parents and children liked the games and stories. Teachers particularly liked the monthly activity calendar and expressed the desire to use the materials in their classrooms. They had been careful to follow instructions about not using it in the classroom. They agreed that probably a meeting once each month was too many for their parents many of whom did not have transportation to meetings. However, a daytime meeting combined with a school open house in the fall resulted in high attendance at all Seminole Nation Head Start Sites. This was not true at Boley which had low parent attendance.

In visiting the Boley school site, teachers had disregarded the instructions and introduced the materials in the classroom. This proved to be fortunate for the project. Parents reported that

the children knew how to play all the games. Children insisted on parents playing with them. When parents were reluctant, children found other people like aunts, older siblings and neighbors to play. Boley is a very small town and it was reported that children were on the street corners doing their math cheers and playing with their "magic elastic." They also were creative in devising new strategies for using the coins in counting by fives. It was also reported by Boley parents that it was important to have the bag with handles for the children to carry home and to use as a storage area for the materials. Children demonstrated a protective attitude toward their own stuff and used the bag to keep it in. This shows the importance of considering the method of transport and storage for young children in homes in which space may be at a premium.

One unexpected outcome of the project has been the use of materials by older students. Teachers and parents reported that older siblings and classmates who used the materials with the preschool children were acquiring math concepts and clarifying ideas which they had previously not mastered. This outcome seems to confirm that some basic understandings are not always acquired through the traditional textbook approach without some prior experiential knowledge of basic ideas such as one to one correspondence.

The use of computers with three and four year old children was investigated by bringing the portable lab to various meetings of parents and children. Researchers were concerned about the need to have software which was within the ability level of the children and would offer speech capabilities as well as appropriate mathematical experiences. The computers chosen were Apple Macintosh Classic because of cost and portability considerations. The software chosen was Math Rabbit (1989) which was described as appropriate for preschool through first grade. Four math games are included in this package including Clown's Counting Games, Tightrope Game, Circus Train Game, and Mystery Matching Game. Prior to the project, the program Number Maze (1989) was not considered within the capability of the young children. Number Maze consists of a maze activity which allows the child to move through magic doors when appropriate math responses are given. However, the program was included in the project for possible use by older children who might be attending the programs. Observations of the children revealed that children in the Barking Waters Project were quite able to use Number Maze and used it on an exploratory basis,

sometimes alone and sometimes with others. No observations of Boley children were made using this program because of the time limits. The experience with observations of the young children and the programs seems to indicate that what seems developmentally appropriate for one group may not be so for another group. More research into the exploratory abilities of young children with various programs in early childhood mathematics would provide important information about how children solve problems in game situations.

Observations of the children and families at the Seminole Nation Head Start indicated that the Seminole children were unusually adept at using the computer and the mouse and in using Math Rabbit. Most parents worked with their children or watched as the children worked. No instructed was given to the children but help was offered as needed. Children worked with other children or alone with great attention to the program. Children easily used the Clowns Counting game and moved on to other games with relative ease. The Seminole Nation Head Start children are quiet and highly focused in their use of the computers. They were able to use the mouse easily and hear the computer voice even when many children and adults worked at the same table.

When computers were taken to the Boley Head Start room, children had more initial difficulty in focusing attention on the computer. They seemed slower to catch on to the use of the mouse and to grasp the relationship between the use of the mouse and what was going on with the game. They tended to gaze across the room and press the mouse button repeatedly. Another problem was the noise level. It was difficult for the children to hear the sound on the computer speakers because they generated so much noise themselves. Their interest and excitement was most often expressed verbally. For this group, external speakers or headphones would be more appropriate. The results of these observations tends to support the idea that not all groups respond in quite the same manner to new technology and learning tools. Boley children are quick verbally and in large motor activities whereas the Seminole children seemed quick in fine motor and grasping relationships.

Parents from all the sites were interested in the computers and many of them worked with their children. Some were less confident in approaching the machine but watched behind their

children.

Teachers convinced the project staff that a mistake was made in not allowing the teachers to use the materials before they were sent home for use by parents. In some cases, the child was the person who initiated the interaction because they were familiar with the activities.

Original plans included the purchase of counting books for the children. Unfortunately, the best books were quite expensive and were limited in the math concepts developed. The decision was made to write books for the children in which specific math concepts were integrated with a story line appropriate for the Oklahoma location and for the developmental level of the children. At the first meeting families listened with smiles of approval as the story "Winter Mouse" was read aloud. Parents were asked if first names of family members could be used as the names of story characters. Subsequent stories and games featured the names of children and family members for the character names. This personalization of the characters proved to be a popular feature for the subjects and made the writing task easier.

Integration of cultural topics proved to be more difficult in spite of the importance of this issue to the project. For the Oklahoma Seminoles, culture presents several problems. First, there is a sense that the cultural patterns of the Seminole are a Florida phenomena. Garbarino (1989) described the descendants of the Seminole who had moved to Oklahoma this way, "These Seminole, however, are not a recognized tribe, and they have retained little of the traditional Seminole culture." It is obvious that little is known about the culture of the Oklahoma Seminoles outside the immediate area and that Garbarino is unaware of the Seminole Nation of Oklahoma which far exceeds the population of the Florida Seminole. The dominate role of the Florida culture seems to have been caused by excessive tourism in Florida and a reluctance of Oklahoma Seminoles to develop and publish children's materials concerning their own very rich culture.

Traditional stories are used to teach lessons to the young and may have many different interpretations. Many Oklahoma Seminoles of today no longer know their clan name and clan symbols or attend clan meetings. Language is an important cultural component among the Seminole but most young people can no longer "talk Indian." Some Seminole people do not wish

to see the cultural stories used in children's material because of the danger of offending the tribal elders while others are indifferent to such considerations. At a meeting to study the clans and clan patchwork held in the museum, all the members of the audience were older people (including the researchers) except for one museum worker.

Within the Natural Math project, cultural items were included with care because of the need to respect the beliefs of the tribal members of all ages and yet to include the cultural patterns within the materials. Seminole cultural materials are particularly suited to the Natural Math project because of the patterns and motifs which are associated with the various clans. These symbols have been preserved in the art form of patchwork designs which form one of the important visual art forms of the tribe. One example of how culture has been used is in the development of shape puzzles such as the bird claw design of the bird clan and the turtle clan puzzle. These puzzles emphasize the math concepts as well as culture of the tribe. There was no direct interpretation of cultural materials since families were the primary interpreters of such material. This method allows each family to share cultural stories in their own way or simply use it as a puzzle with no reference to the background.

Teachers from the tribes of Oklahoma were particularly attracted to the clan puzzles even if the teachers were not from the Seminole tribe. A survey of teachers revealed that they were especially in need of materials in which language, cultural motifs, traditional stories, important people of the tribe and familiar scenes from Oklahoma were included.

An generation of Indian people were send to government boarding schools and taught to reject Indian languages and culture. The result is that young Seminole people of today may have missed the cultural link with previous generations. The Seminole Nation of Oklahoma like other Indian tribes, value the important cultural features which make them who they are as a people. Non-Seminoles also respond with respect to these same cultural features as was demonstrated by the number of other tribes and people who indicated the desire to use the materials with their own Head Start programs. With the growth in cultural self-determination, Indian people including the Seminole, will pass along the culture of the tribe to generations before it is lost forever.

Implications of the Project

This project has demonstrated that cultural motifs, stories, symbols and other cultural features can be integrated within math materials as well as langunge arts and reading for young children. It has also been shown that when this is done, adults as well as the children are attracted and motivated to interact with such activities. As one teacher stated, " You have made math (yuk) fun and interesting." Another mother wrote, "Thank you for caring for my child." This is a critical feature in early childhood education for minority children. Unless those who care for the children are interested in engaging young children in math play, the foundations of math literacy will continue to be limited to a few children of the well educated or mathematically gifted. Math will continue to be something that is only taught in school from math books and workbooks. This is unfortunate, because math is a natural activity for human beings and has been celebrated with the games and patterns of all peoples from all cultures.

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Appendix A

Parent Child Interaction Questionnaire

by Linda Medearis

Appendix D

Natural Math

Evaluation Survey

HOME MATH PARENT/CHILD INTERACTION QUESTIONNAIRE

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The following questions will help you look at what you are doing to promote math with your child at home. Answer each question by circling the number for your response. The numbers mean: **1**=Never, **2**=Not often, **3**=Sometimes, **4**=Frequently, **5**=Always.

1. Do I recite counting rhymes to my child? 1 2 3 4 5

2. Do I have a regular time to explore math in our home? 1 2 3 4 5

3. Do I play the game "What are the numbers printed on the cereal boxes, street signs, and buildings? 1 2 3 4 5

4. Do I show an interest in math on TV, exploring it with my child through conversation? 1 2 3 4 5

5. Do I take time to talk to my child about his new interest or new experiences in math 1 2 3 4 5

6. Do I take my child outside and allow him/her time to observe likenesses and differences in the world around us? 1 2 3 4 5

7. Do I model using mathematics as a daily behavior? 1 2 3 4 5

8. Do I use positional words to my child("on" the table, "over" the box)? 1 2 3 4 5

9. Do I teach him/her rote counting? 1 2 3 4 5

10. Do I teach him/her shapes(square, circle,

triangle, rectangle)? 1 2 3 4 5

HOME MATH PARENT/CHILD INTERACTION QUESTIONNAIRE PAGE 2

11. Do I teach him/her the names of math symbols($, =, +, -)? 1 2 3 4 5

12. Do I let him/her help me cook? 1 2 3 4 5

13. Do I tell him/her often how much I appreciate him/her? 1 2 3 4 5

14. Do I teach him/her to count objects? 1 2 3 4 5